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On the Causes and Predictability of Multi-Year North American Droughts with Applications to Drought Monitoring and Water Management

Drought, especially drought that extends over several years, has major societal and economic impacts. A recent report of the National Drought Policy Commission outlined a national drought policy that emphasizes the importance of drought preparedness over drought relief, and that would set research priorities based on the potential of the research to reduce drought impacts. A key goal of national policy is to improve collaboration among scientists and managers to enhance the effectiveness of observational networks, monitoring, and predictions. This discovery-driven proposal seeks funding from NASAs NEWS and Water Management Programs to carry out a tightly coordinated research and applications effort to improve our ability to mitigate the effects of long-term drought. Specifically, the work consists of a coordinated effort to utilize global climate models and satellite and other observations to 1) better understand the causes of past and current droughts, including the potential impact of global warming, 2) assess the predictability of droughts, and 3) demonstrate the utility of our new understanding and predictive capabilities for drought monitoring and water management.

Anticipated outcomes of this work are 1) an improved understanding of the causes and predictability of long-term drought over North America, including the physical mechanisms that link past and future sea surface temperature changes to hydrological drought, and 2) a demonstration of how NASA observations, together with our improved understanding and predictions can contribute to an early warning system for droughts, provide improved probabilistic drought recovery predictions, and improve water management decision support systems for selected river basins.

The proposed work will use the next generation climate model and associated data assimilation systems that are being developed at the Global Modeling and Assimilation Office (GMAO). We will use new GMAO global reanalysis data products (the TRMM reanalysis, the CERES-reprocessing data set, and the anticipated MERRA reanalysis), NCEP and ECMWF reanalyses, and land surface information from NASAs Global Land Data Assimilation System (GLDAS) and the GMAO atmosphere/land data assimilation system. We will also use information on SST and vegetation from MODIS and AVHRR instruments. The proposed work will capitalize on the expertise and experience of a number of collaborators to ensure that we have sufficiently broad connections to the drought research and relevant applications communities, and various federal and regional stakeholders including the Bureau of Reclamation, the U.S. Army Corps of Engineers, the EPA, the department of agriculture, and various River Basin Commissions.

The work contributes directly to the NEWS grand challenge of documenting and enabling improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change, and the WMP goal of improving existing water management decision support systems. We anticipate coordinating this work with NOAAs new drought mitigation and prediction effort, as well as contributing to CCSP near-term goal to accelerate USGCRP research that assists in the development of public policy and natural resource management tools related to climate change issues.